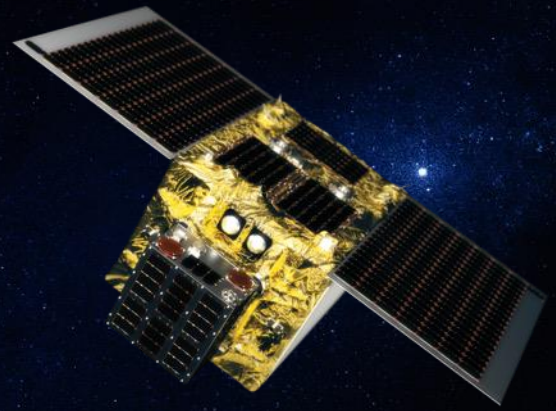
Sustainability in a New Space Era



Nobu Okada, CEO and Founder, Astroscale

19 October 2019

Astroscale mission

Astroscale is a commercial venture with a passion for environmentalism.

Our mission is to secure long-term spaceflight safety and orbital sustainability for the benefit of future generations.

Astroscale: An international company solving a global problem

Founded: May 4, 2013

Team: ~80 (75% engineers)

Capabilities
- System engineering
- Electrical Engineering
- Mechanical Engineering
- Guidance Navigation and Control
- Software development
- Propulsion
- Flight dynamics

Capital: $140M

Offices:
Singapore – HQ, Finance, Legal
Japan – R&D, Ground Station
UK – Ground Control, Licensing
US – Policy, Business Development, R&D

Astroscale U.S. (2019)

Astroscale UK (2017)

Astroscale Japan (2015)

Astroscale Singapore (2013)

Satellites are essential to our daily lives

- Society depends on satellite technology for every aspect of our daily lives.
- Information received from satellites will only become more important in the future.
- If satellite capability is lost we risk losing all of these services.

Traffic Control

Weather Forecast

Broadcasting

Disaster Management

Earth Observation

GPS

Time Stamp

IoT

Kessler Syndrome:
More collisions → More debris → More potential for collisions → Unsustainable orbit

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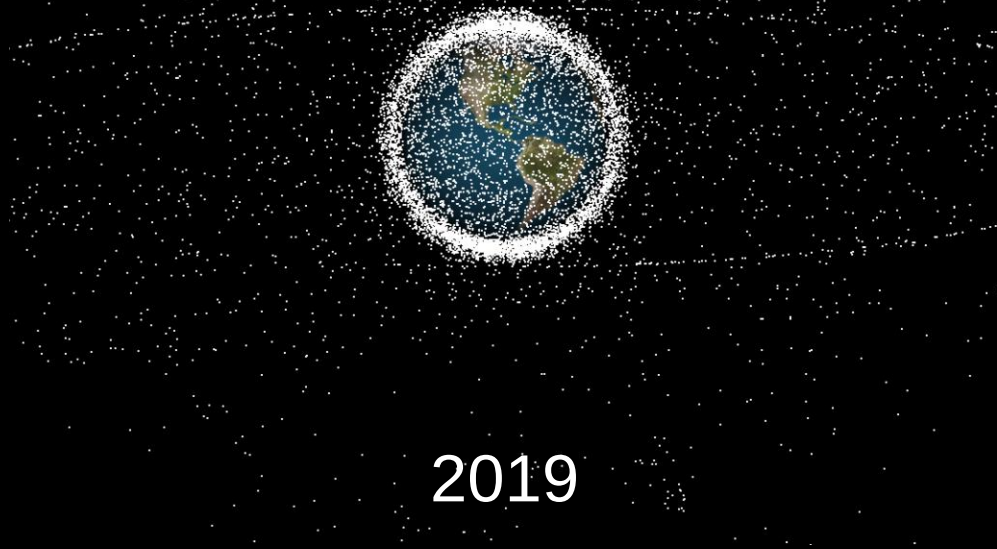


2019

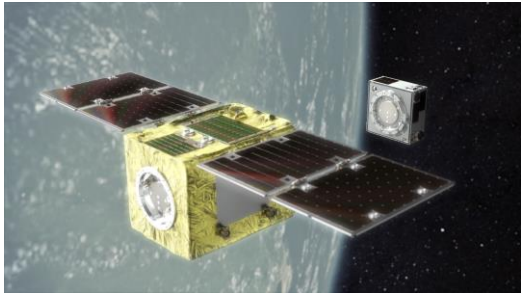
- Approximately 100 rocket launches per year; likely threefold increase in next several years.
- More launches leads to more debris; probability for catastrophic collisions grows.
- Doubling the number of objects increases collision risk by approximately four times.

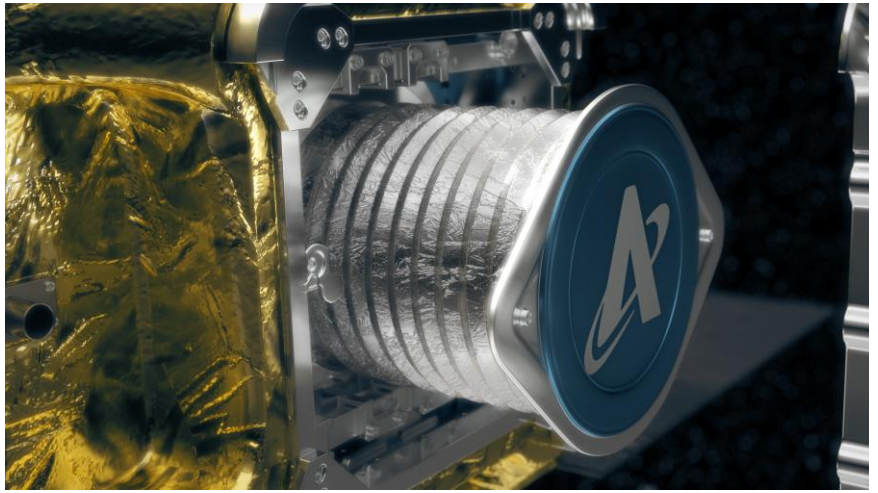
Two Services: EOL and ADR

	End of Life (EOL) “Don’t add any more debris”	Active Debris Removal (ADR) “Remove debris that is already there”
Services		
Potential customers	Constellations, Private Satellite Operators	Governments, International framework
Client Objects	- Satellites that have failed in orbit or reached end of operational lifetime - **150~1,000kg**	- Environmentally Critical Objects - Existing debris - **1,000kg~**
Rationale	- Business continuity and maximize revenue - Adhere to best practices and public demands - Global responsibility	- Demonstrate commitment to orbital sustainability - Assure spaceflight safety for all operators - Global responsibility
Key Technologies	**Semi-cooperative approach and capture**	**Non-cooperative approach and capture**

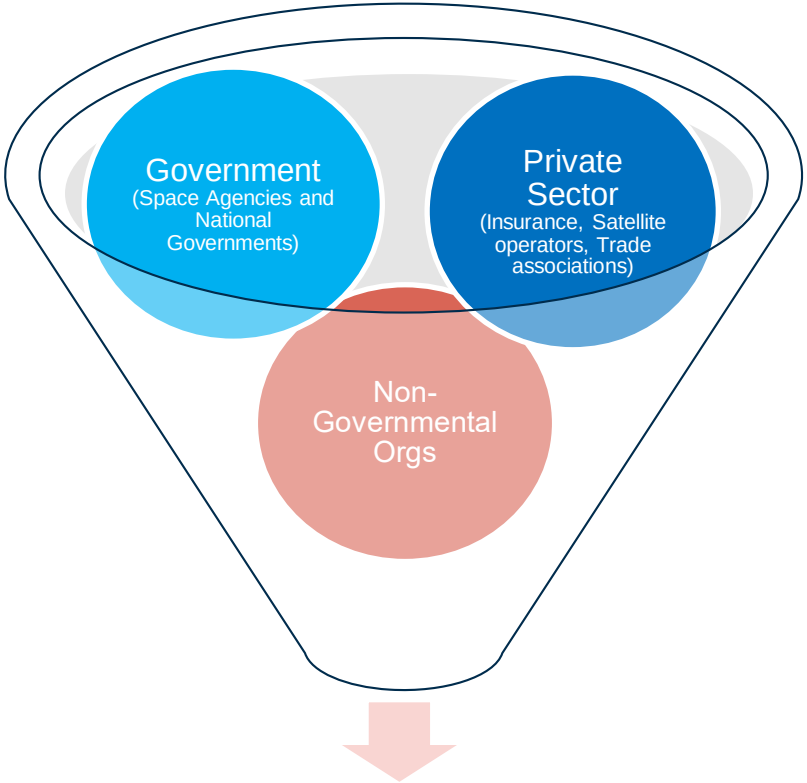
End of Life Services by Astroscale-Demonstration (ELSA-d)

- Scheduled launch: 2020
- World's first EOL demonstration proving end-to-end debris removal technologies.
- Servicer –optical sensing and capture mechanism
- Client – equipped with a rescue package
- Semi-co-operative magnetic capture
- CONOPS video: https://astroscale.com/





Best practices for end-of-life are being created



Best Practices for Orbital Sustainability

- Multiple parties are working together to draft norms/principles for orbital activities.
- Pressure will increase on satellite operators to prepare satellites for retrieval prior to launch.
- Sustainable orbits must be maintained for viability of future business.
- Increasing public awareness leads to actions for mitigation

www.astroscale.com